Functional Outcomes after Geriatric Spinal Column Injuries

Introduction

Over the past several decades, the prevalence of spinal injuries, both to the vertebral column and the spinal cord, among older adults has been on a steady rise. In fact, the occurrence of spinal cord injuries among individuals aged 70 and older has increased almost five-fold from 4% to 15% in the past 30 years.\(^1\) When elderly patients sustain injuries to the spine, the outcome is often measured in terms of mortality and general morbidity.\(^2-5\) The units of measure are usually standardized and do not take into consideration the differences in pre-injury function between the ages of 65-74 and those 75+. Furthermore, there are insufficient reports regarding the patient’s perception of his/her recovery and rehabilitation. Incorporating the patient’s perceived needs into the rehabilitation process may lead to increased compliance and improved rehabilitation.

Our project was designed to evaluate the difference between patients’ subjective view of their outcome and their clinical functional outcome at hospital discharge and at 12 weeks post-discharge. Subjects included patients aged 65 and older who were admitted to St. Elizabeth Health Center in Youngstown, Ohio with an injury to the spinal column or spinal cord as a result of a traumatic event. The Trauma and Orthopaedic Trauma Research Department developed a survey and also utilized the standardized SF-36v2 and the Functional Independence Measure (FIM\(^TM\)). The study sought to address the following: (1) How much does the location of the fracture influence the return to pre-injury level of function? (2) How much does the type of spinal cord injury influence the return to pre-injury level of function? (3) How do the associated injuries influence the functional outcome? (4) At the final assessment, will the patients who were not admitted to a rehabilitation unit perceive their return to function to be significantly less than those who were admitted to a rehabilitation unit? (5) Should more elderly trauma patients be admitted to a rehabilitation center? Shedding light on these issues may help to identify how similar or different the patients’ perceived level of functional recovery was to their clinical outcome.


Executive Summary

Traumatic spinal injuries are on the rise in the elderly population, and this continual trend dictates a need to determine the patients’ perceived level of function after sustaining a traumatic event. A literature review reveals that information pertaining to the patients’ view of their own health and level of function following a traumatic injury is not well documented. The project was developed to assess the patients’ perception of their functional recovery in comparison to their clinical outcome. Because outcomes for our study population are measured in terms of morbidity and mortality, these standardized means do not take into account the differences between in pre-injury function of individuals between the ages of 65-74 and those 75+. It is in our best interest as healthcare providers to evaluate whether patients recover functionally to the same or similar level subjectively as they do objectively. This study found that patients demonstrate different levels of recovery based on subjective and objective testing and in fact, the older age group may have different healthcare requirements than their younger counterparts.
This project was implemented through St. Elizabeth’s Trauma Services in collaboration with the Trauma Research Department and Rehabilitation Services. Heath Dorion, MD, Trauma Surgeon and Assistant Program Director of Surgical Education, was the principal investigator for the study. Dr. Dorion met with the research staff on a weekly or bi-weekly basis to discuss subject screening and enrollment and project challenges. Dr. Dorion further oversaw data storage, study methods, statistical analyses, and completed final reporting. Terrance Puet, MD, Director of Rehabilitation Education, served as a co-investigator and participated in the development of the survey and secured licenses and provided training for the FIM™. Co-investigator Brian Gruber, MD, Trauma Surgeon and Director of Trauma/Critical Care Services, assisted with subject enrollment and project challenges. Barbara Hileman, BA serves as the Research Coordinator for the Trauma and Orthopaedic Trauma Research Department. Mrs. Hileman was responsible for overseeing data collection, entry and storage, hiring an intern, supervising the research assistant and intern, analysis of collected data, final reporting, and day-to-day research duties.

Literature Review

There is an abundance of literature surrounding traumatic spinal injuries pertaining to the elderly population in terms of morbidity and mortality rates, but there is a lack of reports specific to the patients’ perception of their recovery and rehabilitation. Further, it is challenging to address whether patients recover functionally to the same or similar level subjectively as they do objectively.

Historical Perspectives

Outcomes in orthopaedic patients have been examined and quantified as early as 1954. In 1999, Welsch et al. used the SF-36 to determine patient-perceived health status before and after hospitalization in an intensive care unit population. Results showed that self-perception on admission correlated to self-perception after discharge. Historically, the units of measure for assessing self-perception are usually standardized, failing to address the difference in pre-injury function between the ages of 65-74 and those 75+. One main factor leading to misrepresentation of outcomes concerning older adults with spinal injuries is that this population is likely to be physically impaired prior to the injury. However, when the patients’ subjective view of his or her function is considered, the rehabilitation gains are similar to those of younger adults.

Typically, there is a difference in outcomes and mortality between adults < 65 and adults > 65. Due to this contrast, there should be separate analyses of treatment and measures of outcome for these populations to better assess each group. Harris et al. published a study that examined three month and one year mortality in patients 65
or older and found the mortality risk at 3 months increased with age.\textsuperscript{10} They stratified patients into age groups: 65-74, 75-84, and 85+. Mortality rates in those groups at one year were 18\%, 27\%, and 38\%, respectively.\textsuperscript{10} Discrepancies were also found between physician reports and patient surveys.\textsuperscript{18} Physicians underreported adverse events as much as 84\% of the time.\textsuperscript{11} Therefore, in-hospital mortality under represents the true mortality rate of geriatric patients.\textsuperscript{11}

With respect to pre- and post-hospital residences, elderly spinal patients living at home before the injury are likely to return home.\textsuperscript{12} Although spinal fractures can be devastating in elderly patients, they are able to return to independent living.\textsuperscript{12} Conversely, Golob et al. studied disposition at discharge and found that 56\% of patients had unfavorable outcomes (i.e., discharged to skilled or long-term nursing facility).\textsuperscript{13} However, these investigators did not look at functional outcomes at discharge.\textsuperscript{13} In 2010, a retrospective study revealed that return to work rates were lower if the patient had not worked for three months prior to surgery.\textsuperscript{14}

Post et al. used VAS and RMQD questionnaires and found no differences between patients who were treated operatively vs. non-operatively.\textsuperscript{15} However, they did find that patients in both groups suffered some disability compared to healthy subjects, but after five years, the outcomes were similar.\textsuperscript{15} Spaniolas et al. used FIM\textsuperscript{TM} to determine function at discharge and found that patients 70 or older were more likely to have low FIM\textsuperscript{TM} scores than their younger patients.\textsuperscript{14} They demonstrated a three-fold increase in mortality in the 70+ group and found that being older than 70 was one of the strongest predictors of mortality in patients with ground level falls.\textsuperscript{14} Spivak et al. also used the FIM\textsuperscript{TM} and were able to show a correlation between function prior to admission and outcome after hospitalization.\textsuperscript{17} There have been no studies to date that try to determine the difference between functional outcomes of FIM\textsuperscript{TM} and the SF-36 to see if the patients' and physicians' perceptions differ in function and outcome.

Current Status of (the Topic) in Ohio, Surrounding States, and Nationally

According to the U.S. Census Bureau, 13.3\% of citizens in Ohio are aged 65 or older.\textsuperscript{18} The percentage of those aged 65 or older in Mahoning County is 17.8\%, 15.7\% in Trumbull County, and 15\% in Columbiana County.\textsuperscript{18} Compared to the state average and the national average (12.5\%), Mahoning County represents a much higher concentration of the elderly.\textsuperscript{18} The Center for Disease Control and Prevention estimated that in 2003 there were 2 million elderly Americans who sustained injuries from falls.\textsuperscript{19} In 2009, 2.2 million injuries related to falls
were treated in emergency rooms in the U.S., and deaths due to falls have risen sharply over the last decade.\textsuperscript{19,20} At St. Elizabeth’s Health Center, 18\% of all spinal injuries occurred in patients 65 years of age and older during 2007.

**Future Trends (Regionally and Nationally)**

In the past 30 years, the occurrence of spinal cord injuries among adults 70 years of age and older has increased almost five-fold from 4\% to 15\%.\textsuperscript{1} These numbers are likely to continue to rise with the projected increase of the 65 and older U.S. population from 12\% to 20\% by the year 2040.\textsuperscript{21} Also, elderly women over the age of 80 have a 4 in 10 chance of sustaining a vertebral fracture.\textsuperscript{22}

**Financial Issues and Considerations**

The increasing elderly population contributes to the overall healthcare expenditures, creating economic loss and societal burden for caregivers as well.\textsuperscript{23} In addition to initial hospitalization, elderly trauma patients sustaining spinal injuries often require rehabilitation and potentially nursing home care or re-hospitalization in the more severe cases. If the treatment and rehabilitation programs are tailored to the needs of the elderly, healthcare costs could be reduced, and there may be improved outcomes and fewer re-hospitalizations as a result.

**Education and Training Issues and Considerations**

The literature indicates that changes need to be made in the education and training of healthcare workers regarding the evaluation and treatment of older patients sustaining traumatic spinal injuries. A study in *Spinal Cord* found that spinal injury centers can be beneficial for elderly patients with traumatic spinal cord injuries.\textsuperscript{24} However, individuals transferred to a spinal injury center need to be chosen carefully. Elderly patients with complete lesions of the spinal cord will almost always require institutionalized care.\textsuperscript{24} Also, patients who were discharged home had higher FIM\textsuperscript{TM} scores – both at the start of rehabilitation and discharge.\textsuperscript{24} This may mean that a re-evaluation of current rehabilitation models and better follow-up of medical conditions after discharge for elderly spinal injury patients may be in order. If the patient sustains a more severe spinal injury, more customized treatment plans may need to be considered. More inclusive assessment tools (individual’s symptoms, professional, and patient perception) should be developed to determine individual care and rehabilitation plans.\textsuperscript{25} An encompassing assessment tool may help identify problem areas and increase outcomes for elderly patients with traumatic spinal injuries.

**Legislative and Regulatory Issues and Considerations**

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In light of the developing healthcare reform, the details of this new legislation, including the Patient Protection and Affordable Care Act, are yet to be determined. It is uncertain how the healthcare reform will meet the public's demand for healthcare services, considering the increasing aging population. By 2014, individuals under 65 will be covered under new legislation, which may increase outpatient services and put a strain on inpatient services. Meeting the demands of both populations will be a challenge, but improving the outcomes of elderly traumatic spinal injury patients through rehabilitation and post-hospitalization placement may help lessen the strain.

Data and Information Issues and Considerations

The surveys utilized dependent variables consisting of the standardized SF-36v2 and the FIM™. Additionally, a survey developed by the Trauma and Orthopaedic Trauma Department was administered to capture the following data: basic demographic information, mechanism of injury, and pre-injury function, pain, mobility, and level of independence. The SF-36v2 is a reliable and validated questionnaire that is regularly given to patients around the world to evaluate physical and mental health. The FIM™ is a widely accepted functional assessment measure used in rehabilitation. The research team compiled the Functional Outcomes after Geriatric Spinal Column Injuries, a Pre-Injury Patient Questionnaire based on similar surveys found in current medical literature. This survey included the Merle d'Aubigne assessment⁶ to measure pre-injury function and pain and the Parker's Mobility²⁷ to measure pre-injury mobility status.

The final study population fell short of the intended goal. Overall, 208 patients were screened for enrollment into the study. Of those, 116 patients fit study criteria but were not enrolled. This was in part a result of a decrease in elderly spinal injuries from the years the study estimated enrollment was based on. However, the decline was mainly a result of unwillingness to participate (n=68) or unable to enroll patients due to timing (n=23), cognitive status (n=16), transferred to another facility (n=6), and death (n=3). Additionally, there was some level of difficulty in obtaining discharge and 12-week follow-up data due to early discharge, death, and degradation of the patients' mental status. This was partially rectified by maintaining open lines of communication with the nurse in charge of the patient to keep the research staff informed of when the patient would be discharged.

Future studies will require research members to travel to respondents' homes for interviews. Patient income questions also proved to be a topic of great sensitivity to the study population, and different means of attaining this information may have to be entertained.

Analysis of Findings
There were 84 patients enrolled in the study with 32 cervical fractures, 28 thoracic fractures, 33 lumbar fractures, and 8 cord injuries. Of those enrolled, 62 completed the study. The 22 who did not complete the study included 6 patients who expired, 7 that withdrew, and 9 who were lost to follow-up. The mean age was 80 years (65-96); when separated into two categories, 26% (n=20) were aged 65-74 and 74% (n=62) were 75 years or older. The male to female ratio was 1.2 (31% vs. 67%). The vast majority (63%, n=53) of the patients were injured due to a fall from standing height, 12% (n=10) were falls from a height greater than standing, 16% (n=13) motor vehicle crashes and 6% (n=5) other mechanisms. The mean Injury Severity Score (ISS) was 11 (range 0-50), 36% (n=30) mild, 33% (n=28) moderate, 23% (n=19) severe. The mean ISS of those who were discharged home was 7.7 compared to those that went to a rehabilitation or skilled nursing facility, mean=11.4 (p=0.056). The average length of stay was 6.6 days (range 1-33).

The FIM™ is measured on a scale of 0-7, a higher score indicating better clinical function. A higher norm-based score of the SF36v2 also indicates better health. All of the SF36v2 values are based on norm-based scoring. Significant positive correlations were found between: 12wk FIM™ motor score and the SF36v2 12wk PCS (physical component score) (p=0.001); DC FIM™ cognition and the SF36v2 DC MCS (mental component score) (p=0.005); 12wk FIM™ cognition and the 12wk MCS (p=0.016). Significant differences were found between those with improved FIM™ scores and SF36v2 scores from DC to 12wks in each category: FIM™ motor (69%) to SF36v2 PCS (50%) (p=0.001); FIM™ cognitive (33%) to SF36v2 MCS (50%) (p=0.012). Although the majority of the FIM™ scores positively and significantly correlated to the coordinating SF36v2 scores, the FIM™ scores increased after 12 weeks post-discharge more often than the SF36v2. This indicates that the clinical view of geriatric patients’ outcome does not match the patients’ subjective view of their own outcome.

The average FIM™ score fell, as expected, from pre-injury to discharge (mean=115.6 and 96.9, respectively). However, on average, patients did not recover their pre-injury functional level by the end of the 12-week follow-up (mean=105.2). In addition, the total FIM™ decreased by 9% from pre-injury to 12-weeks post-injury FIM™ (p<0.001). The FIM™ was further divided into motor and cognitive scores. The motor score showed a significant decrease in the patients’ function (12%) from pre-injury to the 12-week follow-up (m=82.97 and 72.69 respectively, both p<0.05). The cognitive score also demonstrated a decrease (3%) from pre- to 12-week function (m=32.66 and 31.60, respectively, p<0.05). Only 50% had an improved total FIM™ after DC.
When compared to outcome variables, the FIM™ had strong associations with discharge disposition and age. Fifty-six percent of those who were living at home prior to their injury did not return home upon discharge. There was a significant difference in the mean discharge and 12-week follow-up FIM™ for those who went home (m=111.4 and 104.6, respectively) and those that did not (m=98.2 and 92.1, respectively) (both p<0.05). The FIM™ also had a negative correlation to patient age (p<0.001). However, there was no significant difference in the mean pre-injury FIM™ and the discharge disposition, which signifies that the pre-injury function did not impact the discharge disposition. The younger group had better clinical function as seen in a negative FIM™ scores to patient age correlation (p<0.001). Statistical significance was not established between the ISS score and the 12-week follow-up FIM™ score; however the discharge FIM™ had a significant negative correlation to the ISS score (p<0.05). This indicates the severity of the injury affected the condition at discharge but not necessarily at the 12-week follow-up. Those who died had a lower FIM™ at pre-injury (116.8) and discharge (67.0) than survived (104.5 & 98.9, respectively, both p<0.05).

The mean physical and mental components were analyzed separately. The mean PCS scores increased from 31.2 at discharge to 31.6 at 12-weeks. The mean MCS increased from 48.5 to 48.6. Neither reached statistical significance. Both the PCS and MCS had positive discharge to 12-week correlations (p=0.010 and p=0.038, respectively). Fifty percent of the patients had an increase in their PCS and/or MCS scores. However, only 26% demonstrated both the PCS and MCS scores increased from discharge to 12-weeks. Meaning, 75% of the patients either stayed the same or became worse after discharge in at least one area.

When the SF36v2 was compared to outcome variables, there were few strong associations found. Of those with both a PCS and MCS score that did not increase from discharge to 12-weeks, 49% were discharged home. Similar results were seen when the components were separated (48% PCS and 45% MCS with no increase were discharged home). The older age group (75+) had a higher mean PCS (32.4) at discharge than the 65-74 group (28.0). However, the mean 12-week PCS of the younger age group was significantly higher than that of the older group (m=36.4, a 23% increase and m=29.8, an 8% decrease, respectively, p=0.013). The mean MCS at discharge was 50.2 for the 65-74 group and 47.8 for the 75+ group. The MCS was significantly higher for the younger age group (54.5, 8% increase) compared to the older group (46.2, 5% decrease) at the 12-week follow-up (p=0.023). Both the mean PCS and MCS 12-week scores also had significant negative correlations to age (both p=0.013). Only 12% of those 75+ demonstrated an increase in both the PCS and MCS scores from discharge to 12-weeks compared
to the 65-74 group (59%) (p<0.001; OR 10.3). Statistical significance was not established between the ISS score and the SF36v2 scores. Indicating the severity of the injury did not affect the condition at discharge or 12-week follow-up. No testing was done on mortality due to the SF36v2 not being administered as a pre-injury tool.

The patients were divided into two age categories, 65-74 (group I) and 75+ (group II) to determine if there was a difference in the needs of the older group. Group II had a significantly lower overall clinical function (FIM™) score at pre-injury and at the 12-week follow-up (m=113.7 and 101.4, respectively) than group I (m=121.0 and 115.2, respectively) (both p<0.05). When the motor and cognitive scores are separated, group II only had a significantly lower cognitive score (p<0.05). Although the motor score mean was lower for group II, that did not reach statistical significance when tested alone (group II m=70.4; group I m=78.21). The SF36v2 however, had a different outcome. The mean PCS and MCS at the 12-week follow-up both demonstrated statistical significance when comparing age groups with the 65-74 group having much higher scores than their older counterparts in both. There was also no significant difference in the hospital length of stay between group II and group I (m=6.1 and 8.1, respectively). Discharge disposition also did not reach significance, 52% of group II were discharge to either a rehabilitation center or a skilled nursing facility compared to 63% of group I. Group II accounted for 2/3 (10/15) of the severe injuries (ISS ≥ 16), although group II had a lower mean ISS score (m=9.2) than group I (m=12.2).

Patients in group II were less likely to be discharged to a facility where they would receive rehabilitation, had a shorter hospital length of stay, and lower ISS score; although, they fared worse overall in clinical function. This suggests that the 75 and over age group may require more rehabilitation and recovery time for less severe injuries than their younger counterparts.

Conclusions

This study suggests geriatric spinal injury patients’ subjective view of their health does not coincide with the clinical impression of their functional status. What's more, at 12-weeks post-injury, many are not returning to their pre-injury status regardless of their injury severity, more so in the motor/physical function rather than cognitive/mental function. In addition, the 75 and over age group may require more rehabilitation and recovery time for less severe injuries than their younger counterparts. To properly care for this group of patients, healthcare providers need an improved understanding of the specific needs of both the 75+ and the 65-74 groups. This could lead to better treatment, rehabilitation services, and community programs, as well as optimized patient outcomes, fewer re-hospitalizations, and a reduction in healthcare expenses.
Recommendations

Education needs to be developed and offered to healthcare providers to better care for this subset of the population. Also, when deciding on the disposition of patients, healthcare providers should consider that the age of the patient may have an impact on the level of care required to return the patient to their pre-injury functional status.